

Western Electric Co. Incorporated.  
Equipment Engineering Branch, Hawthorne.

(7 Pages, Page #1).  
Issue 6 - BT-431251  
May 29, 1923.  
Replacing all previous  
Issues.

This M. of O. was prepared from issue 17 of T-431251.

METHOD OF OPERATION.  
FINAL SELECTOR CIRCUIT  
PANEL MACHINE SWITCHING SYSTEM

DEVELOPMENT

1. PURPOSE OF CIRCUIT.

This circuit is for the purpose of completing connections from a manual or full mechanical office to a subscriber's or P.B.X. line in a full mechanical office. The release on "No Test" calls is under control of the calling end.

2. WORKING LIMITS.

This final works over subscriber's line loops of 750 ohms maximum and trunk loops of 1300 ohms maximum.

OPERATION

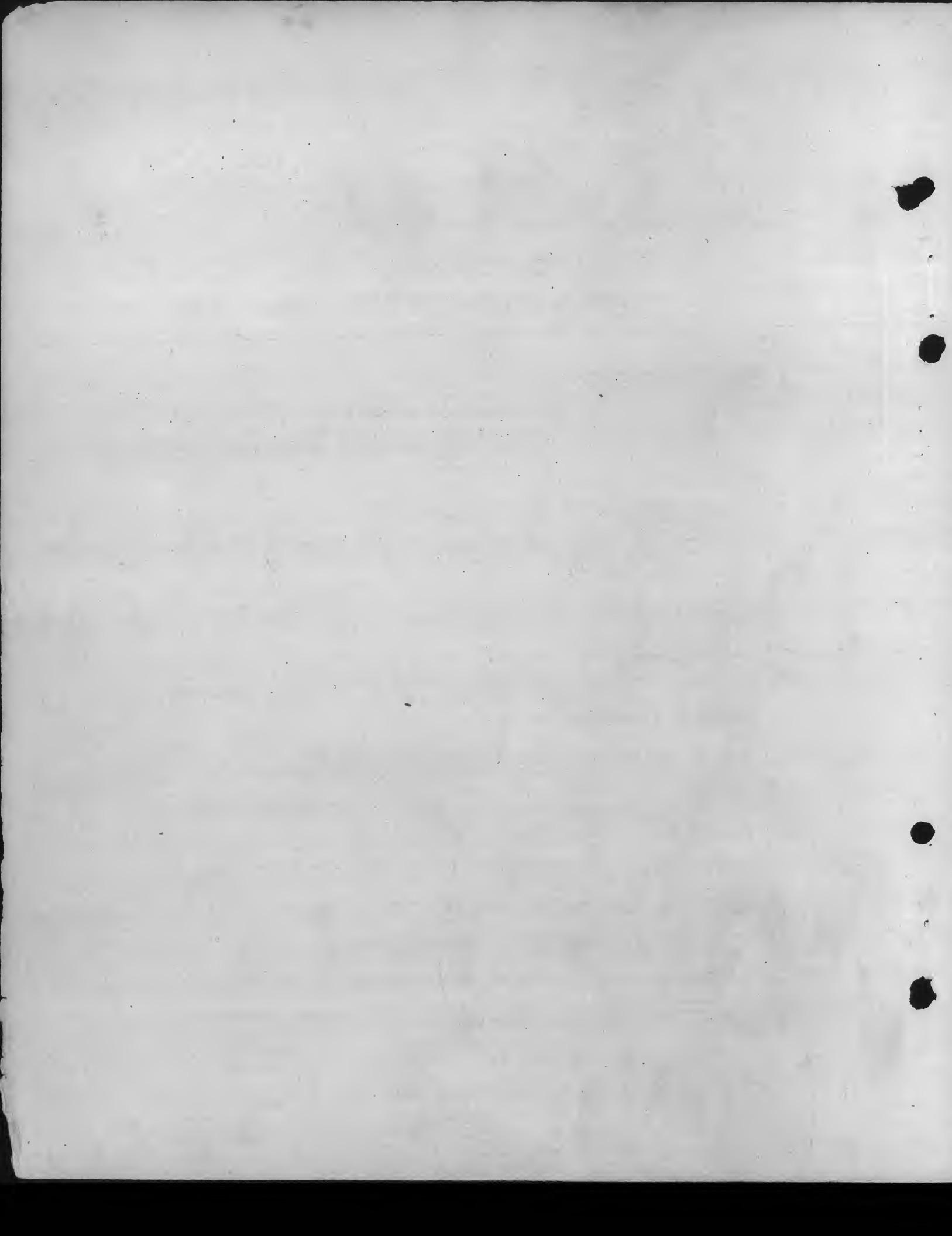
3. PRINCIPAL FUNCTIONS

This circuit is used to establish a connection from the incoming selector multiple to a subscriber's or P.B.X. Line. Its principal functions are:-

- 3.1 Selection of desired line, distinguished between direct and P.B.X. lines, and establishing talking connection.
- 3.2 Testing called line for busy and, if busy individual line, returning selector to normal.
- 3.3. Transmitting busy signal to calling station.
- 3.4. Holding the line busy to other hunting selectors.
- 3.5 Disconnection after conversation.
- 3.6 Tell-tale, "No Test", and premature release features.
- 3.7 Private automatic exchange (PAX) station selections.

4. CONNECTING CIRCUITS

This final functions with the following:



(7 Pages) Page #2.  
Issue 6 - BT-431251.  
May 29, 1923.

- 4.1 Line switch and line finder circuits.
- 4.2 Local cordless and interoffice incoming selector circuits.
- 4.3 Standard two and three digit senders, cordless sender selector circuits and cordless senders.

#### DESCRIPTION OF OPERATION.

##### 5. SEIZURE

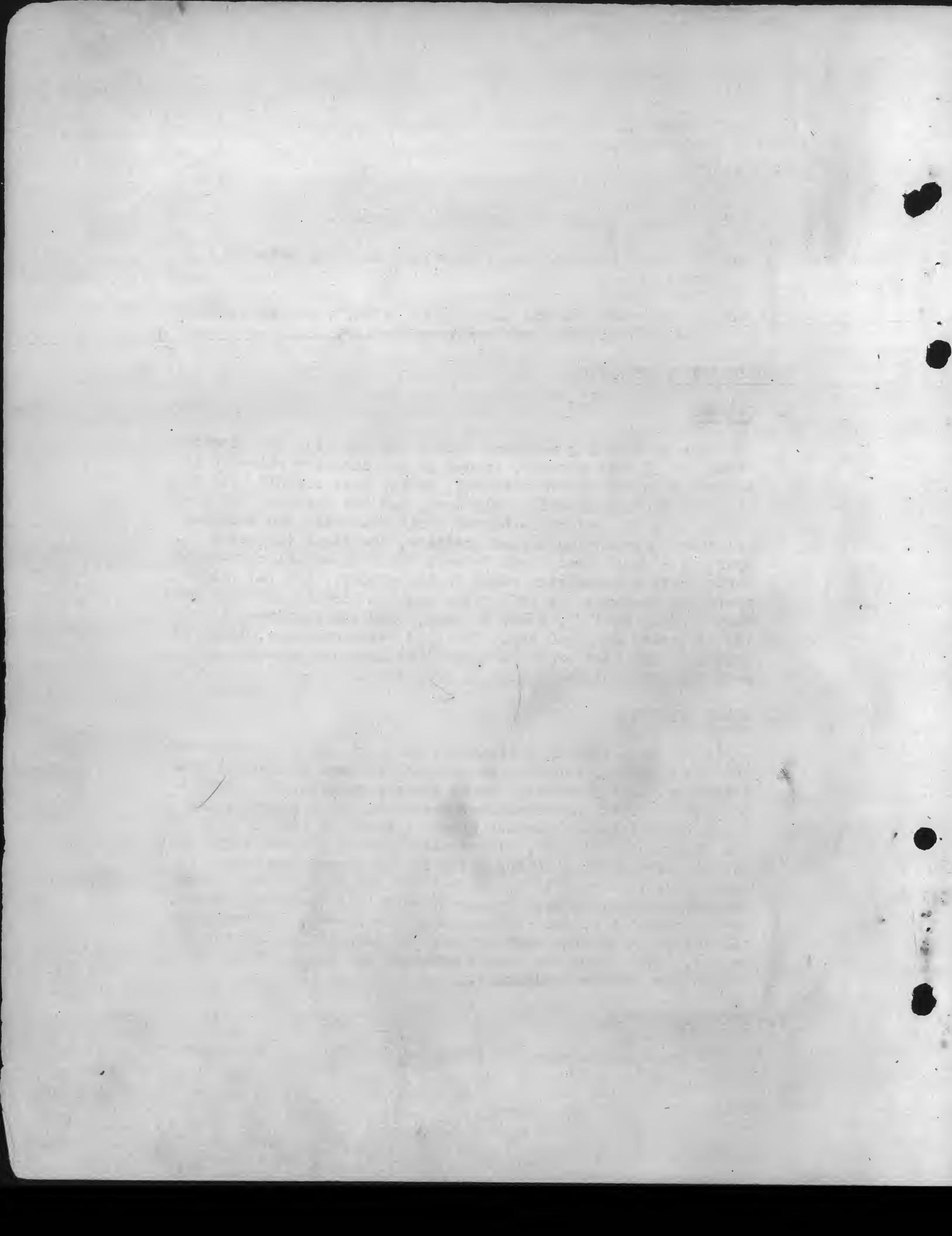
When an incoming selector seizes the tip ring and sleeve terminals of this circuit, ground in the incoming selector is connected to the sleeve terminal, making this circuit test busy to other hunting incoming selectors, and the incoming selector advances to the selection beyond position. With the incoming selector in selection beyond position, the final (L) relay operates through cams H and G over the fundamental circuit in series with the stepping relay in the sender. The (L) relay operated, operates the (TK) relay battery flowing thru the primary winding of (TK), D and E cams, thru the contact of (L) relay to ground on the O cam. The (TK) relay operated, locks to ground on the sleeve of the associated incoming selector circuit and advances the switch to position 2.

##### 6. BRUSH SELECTION

With the switch in position 2, the high speed up-drive magnet (HS) operates, causing the selector to move upward for brush selection. As the selector moves upward, carrying the commutator brushes over the commutator segments, the A segments and brush intermittently connect ground through to the tip side of the fundamental circuit, alternately closing and opening a short circuit around the stepping relay in the associated sender circuit, thus releasing it and permitting its reoperation. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened by the sender, releasing the (L) relay and consequently opening the circuit through the (HS) magnet, which stops the upward movement of the selector, and the switch advances to position 3.

##### 7. GROUP SELECTION.

In position 3, when the fundamental circuit is closed by the



(7 Pages) Page #3.  
Issue 6 - BT-431251.  
May 29, 1923.

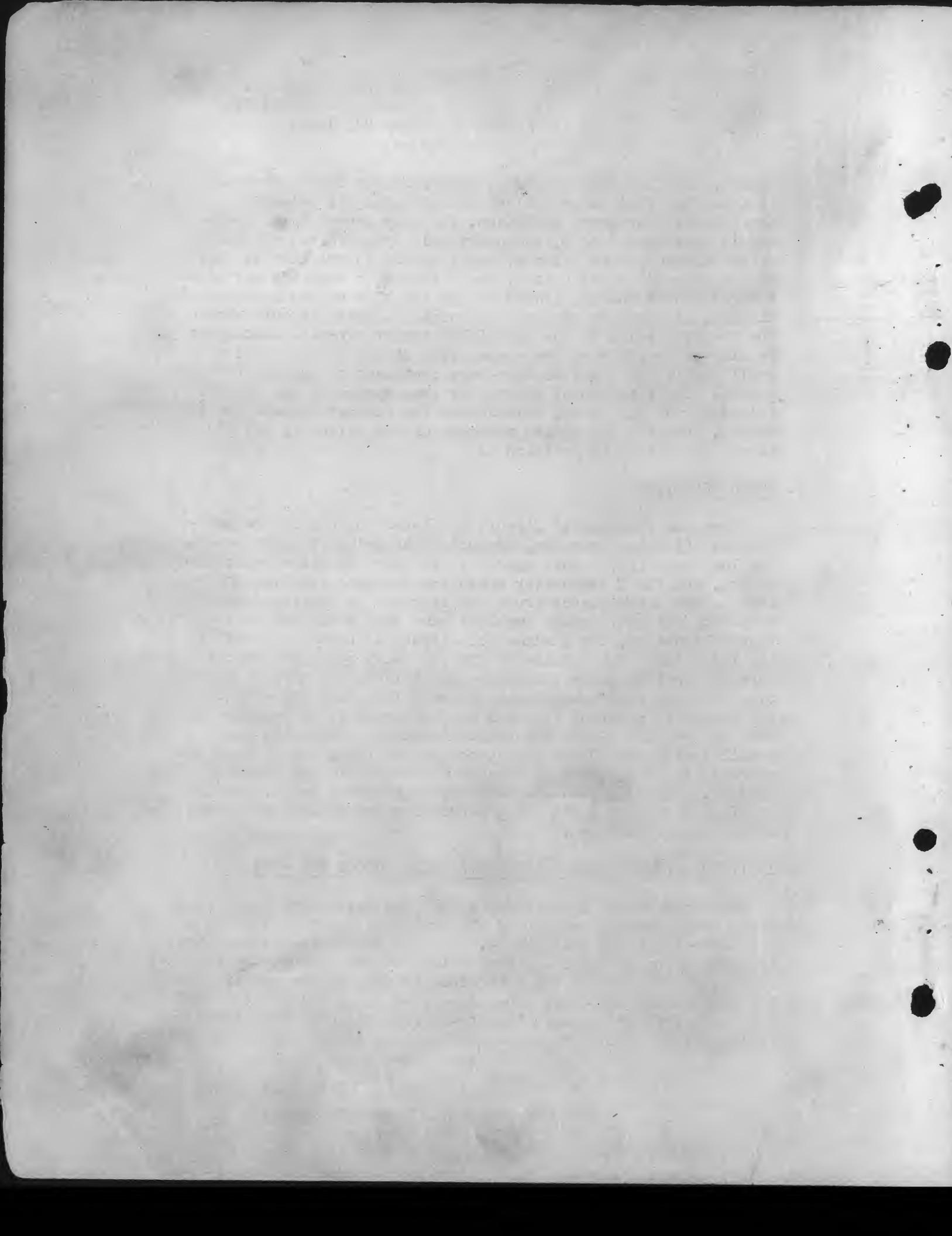
sender, the (L) relay operates, advancing the switch to position 4. The (HS) magnet is now operated and the selector moves upward for group selection. The trip magnet being operated in positions 3 to 5, the previously selected set of brushes is tripped as the selector moves upward in position 4. Also as the selector moves upward, the B commutator segments and brush intermittently connect ground to the tip side of the fundamental circuit, alternately closing and opening a short circuit around the stepping relay in the associated sender circuit, thereby releasing and permitting the reoperation of the stepping relay until sufficient impulses have been sent back to satisfy the sender. The fundamental circuit is then opened by the sender, releasing the (L) relay, which opens the circuit through the (HS) magnet, stopping the upward movement of the selector, and advances the switch to position 5.

8. UNITS SELECTION.

When the fundamental circuit is closed through in the sender, the (L) relay operates, advancing the switch to position 6. The low speed (LS) magnet operates, causing the selector to move upward, and the U commutator brush and segments function the same as the A commutator brush and segments as described previously. When sufficient impulses have been sent back to satisfy the sender, the fundamental circuit is opened, releasing the (L) relay. The release of the (L) relay opens the circuit through the (LS) magnet, stopping the selector brushes on the tip, ring and sleeve terminals of the called line and advances the switch to position 7, the A cam advancing it to position 9. When in position 6-3/4, the (P.B.X.) relay is connected in parallel with the 40 ohm resistance to the ring, but it does not operate due to the high resistance to battery in the incoming circuit. As the switch advances beyond position 7-1/4, ground is disconnected from the ring, permitting the associated incoming circuit to advance.

9. INDIVIDUAL LINE OR FIRST LINE OF A P.B.X. GROUP NOT BUSY

With the switch in position 9, the (L) relay operates through its primary winding, advancing the switch to position 10, the A cam advancing it to position 12. As the switch leaves position 11, the (L) relay releases, connecting battery through the two 110 ohm resistances to the S terminal to operate the cut-off relay in the line circuits. The release of the L relay also advances the switch to position 13, ground from the armature of the (TK) relay advancing the switch to position 14 and ground through



(7 Pages) Page #4.  
Issue 6 - BT-431251.  
May 29, 1923.

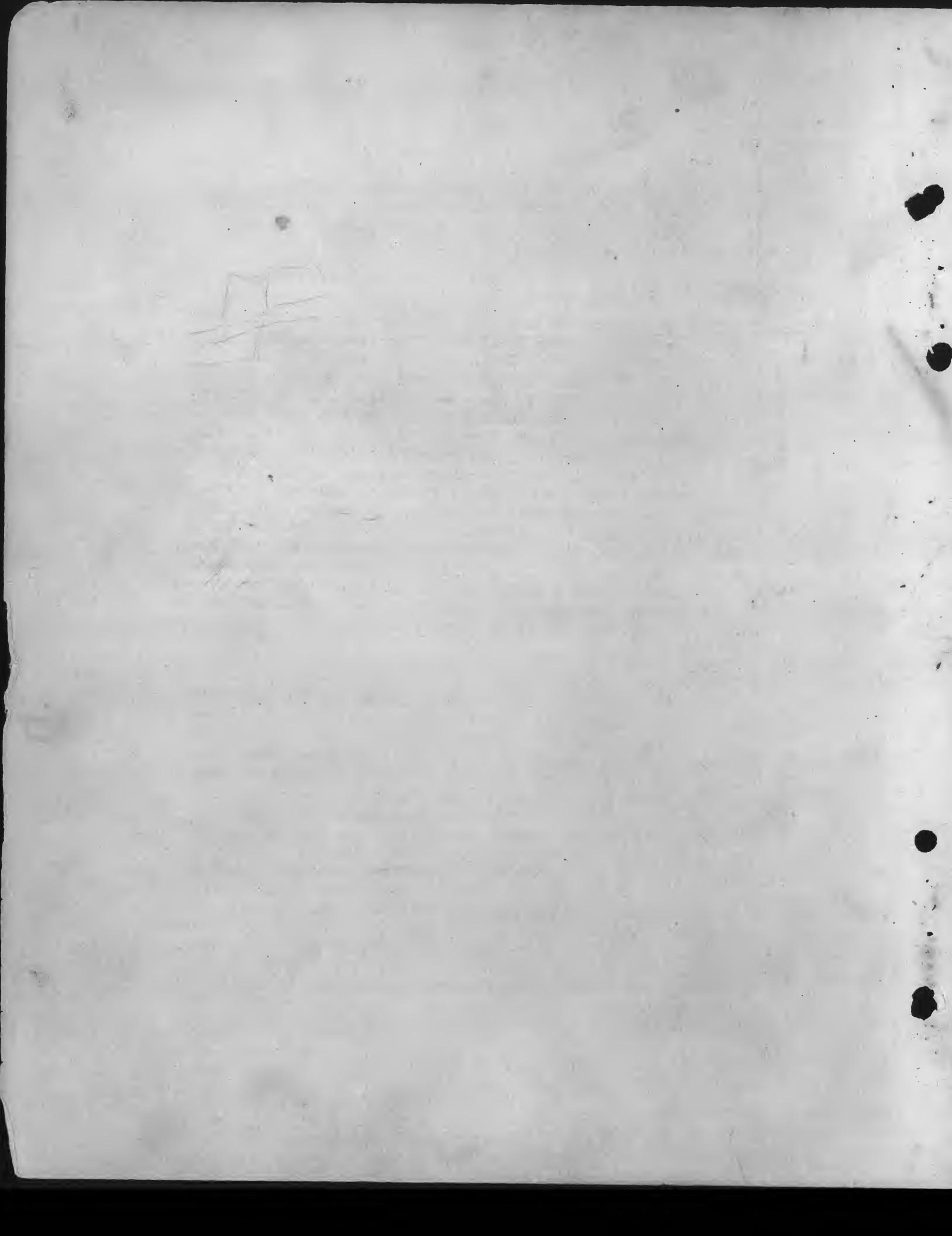
the break contact of the (L) relay advancing the switch to position 15. As the switch passes through position 13-1/2, ground is connected through cam I to the selector group register circuit, operating that register.

#### 10. DISCONNECTION

When the associated incoming selector advances from the talking position, ground is disconnected from the sleeve terminal, releasing the (TK) relay. The (TK) relay released, operates the (L) relay through its secondary winding, advancing the switch to position 16. In position 16, the primary winding of the (L) relay shunted by the 500 ohm 18=AC resistance, is connected thru the loop to the called station, holding the (L) relay operated, and ground is connected through the D cam to the selector time alarm circuit which operates if the switch remains in position 16 for an abnormal length of time. When the receiver is replaced on the switchhook at the called station, the (L) relay releases and advances the switch to position 17, ground on the armature of the (TK) relay advancing the switch to position 18, where the DOWN magnet operates, moving the selector downward. When the selector reaches normal, ground through the Y commutator advances the switch to position 1, releasing the DOWN magnet.

#### 11. NO TEST.

On calls from a cordless position, when the "no test" key is operated, the circuit functions as described in paragraphs 5 to 8 until the switch reaches position 6-3/4 when battery through a low resistance in the cordless sender selector circuit is connected to the ringside of the fundamental circuit, operating the (P.B.X.) relay. The (P.B.X.) relay operated, releases the (TK) relay, which advances the switch from positions 8 to 13 without testing the called line for busy or waiting for (P.B.X.) hunting. The release of the (TK) relay connects ground to the sleeve of the incoming circuit to keep it busy. As the switch leaves position 8-1/4 the (P.B.X.) relay releases. Since the (TK) relay is released, the (L) relay does not operate in position 9 as described in paragraph 9. In position 13, the (TK) relay operates and locks through its primary winding, advancing the switch to position 14. Since the (L) relay is normal, the switch advances to position 15 immediately. Disconnection takes place in the same manner as described in paragraph 10.



(7 Pages) Page #5.  
Issue 6 - BT-431251.  
May 29, 1923.

12. BUSY INDIVIDUAL LINE

In case the called line is an individual line and is busy, the circuit functions as described in paragraphs 5 to 8 until the switch enters position 11. In position 11 high potential battery on the S terminal operates the (P.B.X.) and (TB) relays in series. The (TB) relay operated, holds the L relay operated through its primary winding and the (P.B.X.) relay operated, releases the (TK) relay. The (TK) relay released, advances the switch to position 13. When the switch leaves position 12-1/2, the (P.B.X.) and (TB) relays release, but the (L) relay holds through its secondary winding. In position 13, the (TK) relay operates and locks to ground in the associated incoming selector, advancing the switch to position 14, where the DOWN magnet operates, restoring the selector to normal. When the selector reaches normal, ground on the Y commutator segment advanced the switch to position 17. In positions 13 to 14, the TRIP magnet operates but does not perform any useful function at this time. In position 17, a circuit is closed from interrupted ground over lead D from the busy flash interrupter through cam P to operate and release the (L) relay as controlled by the interrupter. The operation of the (L) relay closes a circuit from lead B of the miscellaneous tone and interrupter circuit to the ringside of the trunk, thereby giving a busy back tone to the calling subscriber. When the calling subscriber or operator disconnects, the associated incoming selector advances to remove ground from the sleeve terminals, thus releasing the (TK) relay. The release of the (TK) relay advances the switch to position 18 where ground on the Y commutator advances it to normal.

13. P.B.X. HUNTING

If the line on whose terminals the selector brushes rest at the end of units selection is the first of a group of P.B.X. lines, and one or more of this group is busy, when the switch reaches position 11, low potential battery on the S terminal operates the (TB) relay but not the (P.B.X.) relay. The (TB) relay operated, holds the (L) relay and as the switch enters position 12, the LS magnet operates, causing the selector to move upward. When an idle terminal is reached, ground potential on the S lead releases the (TB) relay, opening the holding circuit through the primary winding of the (L) relay, which however, holds through its secondary winding to ground on the C commutator.

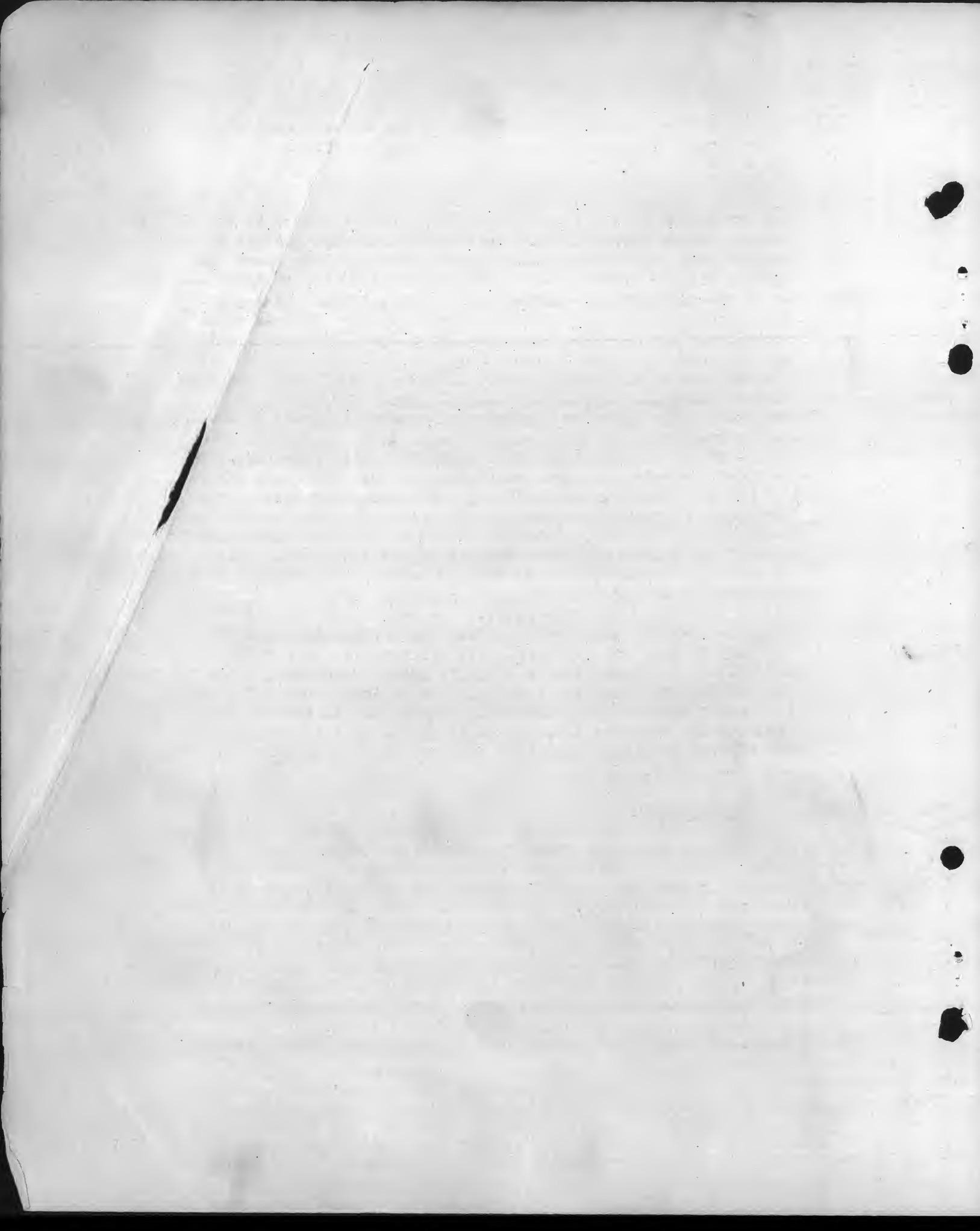


(7 Pages) Page #6.  
Issue 6 - BT-431251.  
May 29, 1923.

The adjustment of the C commutator brush with relation to the tripped sleeve terminal brush is such that it does not break contact with the C commutator segment until slightly after the holding circuit through the winding of the (TB) relay is opened at the time that the sleeve brush breaks contact with the busy terminal and makes contact with the sleeve terminal of an idle line. The (L) relay and the (LS) magnet therefore remain operated and the selector continues to travel upward until the C commutator brush breaks contact with the ground metal segment. At this time, the brushes are slightly above the center of the selected terminals and a locking pawl enters the notch on the rack attached to the brush support rod. With the circuit to ground on the C commutator opened, the (L) relay releases, disconnecting ground from the commutator feed bar (G) and releasing the (LS) magnet. The selector then drops back against the locking pawl, thus centering the brushes on the line terminals. During P.B.X. hunting, ground is connected to the G commutator through cam D from and under control of the (L) relay. This is to prevent the reoperation of the (L) relay by the closing of a circuit from ground through the C commutator brush and segment as the selector drops into place. The release of the (L) relay also advances the switch to position 13. From this point on the circuit functions as previously described in paragraphs 9 and 10. If the last line of a P.B.X. group is reached, since the sleeve condition is the same as for an individual line, the (TB) relay releases in position 12 if the line is idle, or the P.B.X. relay operates in position 12 if the line is busy and the circuit functions from here the same as described for an individual line.

14. P.A.X.DIALING

When the office in which this final circuit is located has lines terminating in private automatic exchanges, this final circuit is arranged with "X" wiring. In this case, ground is connected to the ringside of the trunk until the switch advances from position 14-1/2 to hold the incoming selector in the "Selection Beyond" position. This circuit then functions as under and "Individual Line" to connect to the line where ground on the ring of the P.B.X. trunk holds the incoming in the selection beyond position until all selections have been completed. This circuit is in talking position when P.A.X. selections takes place. Disconnection is the same as for an individual line.



(7 Pages) Page #7.  
Issue 6 - BT-431251.  
May 29, 1923.

15. PREMATURE RELEASE

Should the calling subscriber replace the receiver on the switchhook or the cordless operator depress the disconnect key before the final switch advances from position 14, the incoming selector functions and removes the ground from sleeve, releasing the (TK) relay. The (TK) relay released, advances the switch from any position between 1 and 13 to position 13, where the (TK) relay operates and advances the switch to position 14. The (TK) relay now releases, in turn operating the (L) relay through its secondary winding which operates the DOWN magnet, restoring the selector to normal. In positions 13 to 14, the TRIP magnet is energized so that in case this premature release starts before the final has advanced beyond brush tripping zone, the trip finger shall not be in the way of the returning selector brushes. When the selector reaches normal, ground on the Y commutator advances the switch to position 17, ground on the armature of the (TK) relay advancing the switch to position 18 and ground on the Y commutator advancing it to normal.

16. TELL-TALE

Should the selector travel to the top of the frame, "Tell-Tale" position, during selection in positions 2, 4, 6 or 12, ground on the X commutator brush and segment advances the switch to position 13. The switch now advances to position 15, and awaits the advance of the incoming circuit to release the (TK) relay. From this point the circuit is returned to normal as described in paragraph 10.

17. TEST JACK

Jack MB is for the purpose of making this circuit busy during testing. Jack T is used to test the operation of this circuit.

ENG.--AFH  
5/29/23

CHK'D--JI

APPROVED--H.L.MOYNES  
E.R.C.

